

AGRICULTURE

Project Fact Sheet



SEPARATION OF ZEIN FROM BIOETHANOL PROCESS STREAMS

ENERGY-EFFICIENT, LOW-COST ZEIN PRODUCTION ALLOWS ECONOMICAL ETHANOL PRODUCTION

Benefits

- Offers savings of 30 trillion Btu by 2010 from use at 11 plants
- Enables ethanol to be produced at a more competitive price by selling zein, a coproduct
- Use of biodegradable zein replaces petroleum-derived nondegradable plastics

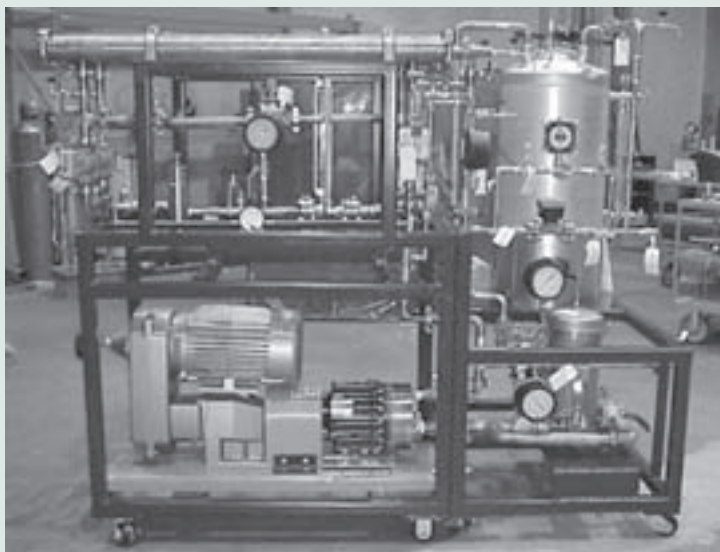
Applications

This technology will allow a new, non-petroleum-based polymer, zein, to be produced from renewable agricultural resources for a range of applications such as adhesives, coatings, food additives and biodegradable plastics.

Ethanol produced by the fermentation of corn (bioethanol) is an environmentally friendly source of oxygenates for gasoline fuels. The gradual phase-out, for environmental reasons, of MTBE, the principal current oxygenate, has increased bioethanol demand significantly. By 2005, when MTBE is to be completely phased out, total U.S. bioethanol production is expected to be 4 to 5 billion gallons per year.

Production of bioethanol from corn currently relies on a government subsidy to be economical. A significant portion of the cost of ethanol production could be defrayed by producing zein, a corn protein currently discarded as waste, as a coproduct. If the cost of producing zein can be reduced to about \$1/lb, a large market will develop for the product as a biodegradable plastic, a food additive, and a paper-coating material. The key to low-cost zein production is an energy-efficient, low-cost membrane process to separate zein from the ethanol corn extract solution. Concentration and purification of zein by ultrafiltration significantly reduces the energy consumption of spray-drying the zein/ethanol solution.

PILOT TEST SYSTEM



Photograph of pilot test system used for evaluating organic-liquid-stable ultrafiltration membranes. This explosion-proof system is capable of operating at up to 1000 psig pressure and 70°C.



Membrane Technology and Research, Inc. (MTR) has made membrane modules with the required selectivity, flux and stability, and these membrane modules have been demonstrated in bench-scale tests. Sufficient zein has already been produced to allow preliminary tests of the product by potential end-users, who have expressed a high level of interest in the product.

Project Description

Goal: To obtain sufficient pilot-scale membrane-module operating data to allow a proof-of-concept system to be designed, built and operated in a subsequent demonstration.

In the extraction of zein from a solution of ethanol two membrane processes are to be used: ultrafiltration and nanofiltration. The membranes for nanofiltration are fully developed but the ultrafiltration membranes to separate and concentrate the zein will be developed in this project. A number of membrane modules are to be constructed and tested to determine which ones to use in the pilot plant.

Progress and Milestones

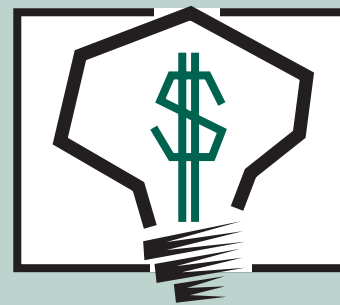
The following are the main tasks to be performed:

- Prepare organic-liquid-permeable, stable composite membranes and modules.
- Test membrane module performance using solutions of varying zein concentrations to determine the best membranes to use in the pilot plant.
- Develop a process flow scheme for the membrane portion of the pilot plant including a piping and instrumentation diagram.

Economics and Commercial Potential

This research is part of a larger program to produce low-cost zein from corn being undertaken by a consortium of companies. A number of potential customers for zein produced at the \$1.00/lb level have been identified. The zein-membrane purification is critical to the success of this effort.

Commercial introduction of this technology is expected by 2005. Annual energy savings by 2010 would be 30 trillion Btu from 11 plants. By 2020 the savings would grow to 67 trillion Btu from 25 plants using the technology.



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and to conduct early development. Ideas that have significant energy-savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

For project information, contact:

Dr. Anurag Mairal
Membrane Technology and
Research, Inc. (MTR)
1360 Willow Road, Suite 103
Menlo Park, CA 94025
Phone: (650) 328-2228
Fax: (650) 328-6580
amairal@mtrinc.com

For more information about the
Inventions and Innovation Program,
contact:

Lisa Barnett
Program Manager
Inventions and Innovation Program
Phone: (202) 586-2212
Fax: (202) 586-7114
lisa.barnett@ee.doe.gov

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Office of Weatherization and
Intergovernmental Program
Energy Efficiency and
Renewable Energy
U.S. Department of Energy
1000 Independence Avenue SW
Washington, D.C. 20585-0121



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